

Industrial Wireless Sensor Networks Market – Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented By Sensor (Pressure Sensor, Temperature Sensor, Level Sensor, Flow Sensor, Biosensor, and Others), By Technology (Zigbee, Bluetooth, Wi-Fi, and Others), By Industry Vertical (Oil & Gas, Automotive, Manufacturing, Healthcare, and Others), By Region, By Competition, 2018-2028

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Abstracts

Global Industrial Wireless Sensor Networks Market was valued at USD 1.03 Billion in 2022 and is anticipated to project robust growth in the forecast period with a CAGR of 11.23% through 2028. The Global Industrial Wireless Sensor Networks (IWSN) Market is experiencing substantial growth, driven by the increasing demand for advanced solutions that cater to the evolving needs of the technology and data management sectors. Industrial wireless sensor networks have emerged as pivotal components in optimizing various industrial processes, enhancing efficiency, reliability, and safety. This analysis explores the transformative impact of industrial wireless sensor networks in today's technological landscape, underlining their crucial role in delivering agile, secure, and technologically advanced industrial services. As industries continue to evolve and rely increasingly on automation and data-driven decision-making, industrial wireless sensor networks have become indispensable tools for collecting real-time data from various industrial processes. These networks consist of sensors and communication devices that wirelessly transmit data to a central monitoring and control system. They enable industries to monitor and manage operations, predict equipment failures, and optimize resource utilization. One of the primary drivers for the increasing adoption of industrial wireless sensor networks is the pursuit of operational efficiency and cost

savings. In an era where industries face growing pressure to reduce operational costs while maintaining or improving productivity, these networks empower organizations to achieve these goals. They provide real-time insights into industrial processes, allowing for proactive maintenance and the identification of efficiency improvements. This automation reduces the need for manual data collection and monitoring, minimizing human intervention and the risk of errors.

Safety is a paramount concern in industrial environments, given the potential risks associated with various processes. Modern industrial wireless sensor networks incorporate advanced safety features, such as intrusion detection, emergency shutdown systems, and real-time monitoring of hazardous conditions. These safety measures not only protect personnel and assets but also ensure compliance with regulatory requirements, safeguarding organizations from potential legal and financial risks. Furthermore, industrial wireless sensor networks contribute to the efficient management and monitoring of industrial equipment and infrastructure. They enable predictive maintenance by continuously monitoring the health and performance of industrial machinery. By detecting anomalies and potential failures early, organizations can schedule maintenance activities to reduce downtime and extend the lifespan of equipment. In an era of Industry 4.0 and digital transformation, industrial wireless sensor networks play a pivotal role in enabling automation, connectivity, and data-driven decision-making. These networks facilitate the integration of industrial processes with digital systems, allowing for remote monitoring and control. This connectivity enhances agility and responsiveness, enabling industries to adapt quickly to changing market conditions and customer requirements.

In conclusion, the Global Industrial Wireless Sensor Networks Market is experiencing significant growth as organizations recognize the pivotal role of these networks in achieving operational efficiency, safety, and agility in industrial processes. As industries continue to embrace digital transformation, industrial wireless sensor networks will remain an essential component, driving innovation and security in industrial services, and ultimately enhancing the competitiveness of organizations worldwide. This transformation underscores the significance of industrial wireless sensor networks in shaping the future of industrial processes and technological innovation.

Key Market Drivers:

Increasing Demand for Industrial Automation and Industry 4.0:

The Global Industrial Wireless Sensor Networks (IWSN) Market is experiencing

remarkable growth, primarily driven by the increasing demand for industrial automation and the adoption of Industry 4.0 principles. As industries worldwide strive to enhance productivity, efficiency, and competitiveness, the integration of wireless sensor networks has emerged as a pivotal enabler of these objectives.

One of the primary driving forces behind the adoption of IWSN is the ongoing shift toward Industry 4.0, also known as the Fourth Industrial Revolution. Industry 4.0 represents a fundamental transformation of traditional manufacturing and industrial processes, characterized by the convergence of digital technologies, data analytics, and automation. In this context, IWSN plays a central role by providing real-time data collection and communication capabilities within industrial environments. The demand for industrial automation is surging across various sectors, including manufacturing, oil and gas, healthcare, agriculture, and logistics. Industrial wireless sensor networks facilitate this automation by enabling seamless communication between sensors, machines, and control systems. This connectivity allows for the automation of critical tasks, predictive maintenance, and the optimization of production processes. Moreover, IWSN empowers organizations to gather extensive data from various sensors deployed across industrial facilities. This data encompasses information on equipment performance, environmental conditions, energy consumption, and more. By harnessing this wealth of data, businesses can implement data-driven decision-making, resulting in improved operational efficiency and cost savings. Furthermore, Industry 4.0 emphasizes the concept of the 'smart factory,' where interconnected devices and systems work together in a highly coordinated and efficient manner. IWSN forms the backbone of smart factories, facilitating seamless communication among sensors, robots, machines, and enterprise systems. This connectivity enables real-time monitoring and control of manufacturing processes, leading to reduced downtime, enhanced quality control, and increased production flexibility. In summary, the rising demand for industrial automation and the adoption of Industry 4.0 principles are driving the growth of the Global Industrial Wireless Sensor Networks Market. IWSN solutions are at the forefront of this transformation, enabling industries to achieve higher levels of automation, data-driven decision-making, and operational excellence. As organizations continue to embrace digitalization, the significance of IWSN in shaping the future of industrial processes and competitiveness cannot be overstated.

Advancements in Wireless Communication Technologies:

The Global Industrial Wireless Sensor Networks (IWSN) Market is experiencing significant growth, propelled by continuous advancements in wireless communication technologies. These technological innovations have expanded the capabilities and

applications of IWSN across various industries, making them more versatile, reliable, and accessible. One of the key drivers behind the growth of IWSN is the ongoing evolution of wireless communication protocols and standards. Traditional wired sensor networks often faced limitations in terms of scalability and flexibility. However, wireless technologies, such as Wi-Fi, Bluetooth, Zigbee, LoRaWAN, and 5G, have overcome many of these constraints, enabling seamless and reliable data transmission over extended distances. The widespread availability and adoption of these wireless communication technologies have made it easier for industries to deploy IWSN solutions in diverse environments. For example, in manufacturing settings, where equipment and processes are distributed across large areas, wireless sensors can be strategically placed to monitor various parameters like temperature, pressure, and vibration. These sensors can transmit data wirelessly to centralized control systems, providing real-time insights into industrial operations. Furthermore, advancements in energy-efficient wireless protocols have extended the battery life of sensor nodes, reducing the maintenance and replacement costs associated with IWSN deployments. This improved energy efficiency ensures that sensors can operate reliably for extended periods without requiring frequent battery replacements. Additionally, the emergence of 5G technology has opened up new possibilities for IWSN applications. 5G offers low latency, high bandwidth, and massive device connectivity, making it well-suited for mission-critical industrial applications. It enables real-time data transmission and supports applications like remote monitoring, autonomous robotics, and augmented reality within industrial settings. Moreover, the convergence of wireless sensor networks with the Internet of Things (IoT) has expanded the scope of IWSN deployments. IoT platforms provide the infrastructure for collecting, analyzing, and visualizing data from various sensors, offering businesses actionable insights for informed decision-making. This integration enhances the overall value proposition of IWSN solutions. In conclusion, continuous advancements in wireless communication technologies are driving the growth of the Global Industrial Wireless Sensor Networks Market. These innovations have overcome previous limitations, enabling more versatile, reliable, and energy-efficient IWSN deployments across various industries. As wireless communication technologies continue to evolve, the potential for IWSN to transform industrial processes and enhance efficiency remains substantial.

Growing Emphasis on Predictive Maintenance and Operational Efficiency:

The Global Industrial Wireless Sensor Networks (IWSN) Market is witnessing robust growth, fueled by the increasing emphasis on predictive maintenance and operational efficiency across various industries. Organizations are recognizing the value of IWSN solutions in proactively monitoring equipment, reducing downtime, and optimizing

resource utilization. One of the primary challenges is managing the scalability of IWSN deployments. As organizations expand their sensor networks to cover larger areas or accommodate more devices, they encounter challenges related to network congestion, signal interference, and bandwidth limitations. Ensuring that the network can scale seamlessly to meet growing data demands while maintaining low latency and high reliability is a complex undertaking.

Effective network management is essential for maintaining the performance and security of IWSN systems. Monitoring the health and status of individual sensor nodes, diagnosing and addressing connectivity issues, and optimizing data routing paths are vital tasks. However, as IWSN deployments grow in size and complexity, managing these networks manually becomes increasingly impractical. To tackle scalability and network management challenges, organizations are turning to advanced solutions such as edge computing and artificial intelligence (AI). Edge computing allows data processing to occur closer to the data source, reducing the need for data to travel long distances within the network. This approach can alleviate congestion and reduce latency in large-scale IWSN deployments.

Additionally, AI-driven network management and predictive analytics can provide real-time insights into network performance and predict potential issues before they cause disruptions. Machine learning algorithms can optimize data traffic, adjust routing paths, and identify anomalies or security threats.

Furthermore, the adoption of cloud-based IWSN platforms can simplify network management by providing centralized control and monitoring capabilities. These platforms offer scalable and secure solutions for managing sensor networks, enabling remote configuration, firmware updates, and data visualization. In conclusion, the Global Industrial Wireless Sensor Networks (IWSN) Market faces several challenges related to security and data privacy, interoperability and standardization, and scalability and network management. Addressing these challenges requires collaboration between industry stakeholders, the development of common standards, and the adoption of advanced technologies like edge computing and AI-driven network management. As industrial organizations continue to embrace IWSN solutions to enhance automation and data-driven decision-making, overcoming these challenges will be crucial for successful implementation and long-term benefits.

Key Market Challenges

Security and Data Privacy Concerns:

One of the foremost challenges facing the Global Industrial Wireless Sensor Networks (IWSN) Market is the growing concern over security and data privacy within industrial environments. As industries increasingly adopt IWSN solutions to enhance automation and data-driven decision-making, they must address the potential vulnerabilities and risks associated with wireless communication and data transmission.

Security threats in industrial settings can have significant consequences, including operational disruptions, data breaches, equipment damage, and safety hazards. Malicious actors may attempt to exploit weaknesses in IWSN networks to gain unauthorized access, manipulate data, or disrupt critical processes. Therefore, ensuring the security and integrity of IWSN deployments is of paramount importance.

One significant challenge is the protection of data in transit. IWSN relies on wireless communication protocols to transmit data between sensors, gateways, and control systems. These wireless transmissions can be susceptible to interception or tampering if not adequately secured. Implementing robust encryption mechanisms and authentication protocols is essential to safeguard data integrity and confidentiality.

Furthermore, the proliferation of IoT devices and the interconnectivity of IWSN networks increase the attack surface for potential cyber threats. Each sensor node represents a potential entry point for attackers, making comprehensive security measures crucial. Organizations must regularly update and patch devices, employ intrusion detection systems, and establish access controls to mitigate security risks effectively.

Data privacy is another critical concern, particularly in industries where sensitive or proprietary information is collected and transmitted. Compliance with data protection regulations, such as GDPR and CCPA, requires organizations to implement strict data governance and privacy measures. This includes ensuring that personally identifiable information (PII) and sensitive data are handled and stored securely, with clear consent mechanisms in place. To address these challenges, collaboration between IWSN providers, industrial organizations, and cybersecurity experts is essential. Ongoing security assessments, threat modeling, and penetration testing should be conducted to identify and mitigate vulnerabilities. Additionally, employee training and awareness programs can help build a culture of cybersecurity vigilance within industrial organizations.

Interoperability and Standardization:

Interoperability and standardization present significant challenges in the Global Industrial Wireless Sensor Networks (IWSN) Market. As IWSN solutions continue to evolve and diversify, ensuring seamless communication and compatibility between different devices, sensors, and platforms becomes increasingly complex. Industrial environments often comprise a mix of legacy systems and newer, IoT-enabled devices. These disparate systems may rely on different communication protocols and data formats, making it challenging to achieve interoperability and data integration. For example, sensors from various manufacturers may use proprietary communication protocols, hindering their ability to work together seamlessly.

Standardization efforts, while essential for promoting compatibility, can also be slow to develop and implement. The existence of multiple standards and protocols can lead to fragmentation within the IWSN market, creating confusion for industrial organizations seeking to adopt these technologies. This lack of standardization can result in higher implementation costs and limited flexibility in choosing compatible devices.

Furthermore, ensuring the robustness and reliability of IWSN networks across diverse industrial environments can be challenging. Industrial settings often feature harsh conditions, such as extreme temperatures, electromagnetic interference, and physical obstacles, which can impact wireless signal strength and reliability. Standardizing and optimizing IWSN solutions to perform consistently in these challenging environments is a significant challenge. Addressing interoperability and standardization challenges requires collaboration among industry stakeholders, including sensor manufacturers, communication protocol developers, and industry associations. Efforts to establish common communication protocols, data exchange formats, and interoperable device profiles can facilitate seamless integration and data sharing within IWSN ecosystems.

Scalability and Network Management:

Scalability and effective network management present substantial challenges in the Global Industrial Wireless Sensor Networks (IWSN) Market. Industrial organizations often deploy IWSN solutions across large and complex facilities, requiring the management of numerous sensors, nodes, and gateways to ensure optimal performance and reliability. One of the primary challenges is managing the scalability of IWSN deployments. As organizations expand their sensor networks to cover larger areas or accommodate more devices, they encounter challenges related to network congestion, signal interference, and bandwidth limitations. Ensuring that the network can scale seamlessly to meet growing data demands while maintaining low latency and high reliability is a complex undertaking. Effective network management is essential for

maintaining the performance and security of IWSN systems. Monitoring the health and status of individual sensor nodes, diagnosing and addressing connectivity issues, and optimizing data routing paths are vital tasks. However, as IWSN deployments grow in size and complexity, managing these networks manually becomes increasingly impractical. To tackle scalability and network management challenges, organizations are turning to advanced solutions such as edge computing and artificial intelligence (AI). Edge computing allows data processing to occur closer to the data source, reducing the need for data to travel long distances within the network. This approach can alleviate congestion and reduce latency in large-scale IWSN deployments. Additionally, AI-driven network management and predictive analytics can provide real-time insights into network performance and predict potential issues before they cause disruptions. Machine learning algorithms can optimize data traffic, adjust routing paths, and identify anomalies or security threats. Furthermore, the adoption of cloud-based IWSN platforms can simplify network management by providing centralized control and monitoring capabilities. These platforms offer scalable and secure solutions for managing sensor networks, enabling remote configuration, firmware updates, and data visualization.

In conclusion, the Global Industrial Wireless Sensor Networks (IWSN) Market faces several challenges related to security and data privacy, interoperability and standardization, and scalability and network management. Addressing these challenges requires collaboration between industry stakeholders, the development of common standards, and the adoption of advanced technologies like edge computing and AI-driven network management. As industrial organizations continue to embrace IWSN solutions to enhance automation and data-driven decision-making, overcoming these challenges will be crucial for successful implementation and long-term benefits.

Key Market Trends

Integration of Edge Computing for Real-Time Data Processing:

One of the prominent trends shaping the Global Industrial Wireless Sensor Networks (IWSN) Market is the increasing integration of edge computing for real-time data processing and analysis. Edge computing refers to the practice of processing data closer to the source, typically at the network's edge, rather than sending it to a centralized cloud or data center. This trend is gaining momentum as industries seek to enhance the efficiency and responsiveness of their industrial processes. In the context of IWSN, edge computing plays a crucial role in enabling rapid decision-making and reducing latency. Traditional cloud-based solutions may introduce delays in data

transmission and analysis, which can be impractical for time-sensitive applications such as predictive maintenance, quality control, and safety monitoring. By processing sensor data at the edge, near the sensors themselves, organizations can achieve real-time insights and immediate actions. One key advantage of edge computing in IWSN is its ability to filter and preprocess data locally. Sensors generate vast amounts of data, much of which may be redundant or irrelevant for immediate decision-making. Edge devices can analyze incoming data, identify critical events or anomalies, and transmit only relevant information to centralized systems or human operators. This data reduction at the edge minimizes network traffic, conserves bandwidth, and optimizes resource utilization. Moreover, edge computing facilitates greater autonomy in industrial environments. Sensor nodes and edge devices can execute predefined logic and decision-making algorithms without relying on constant connectivity to central servers. This autonomy ensures that critical processes continue to function even in cases of network interruptions, enhancing the overall reliability and robustness of IWSN deployments. As industries continue to adopt edge computing, IWSN solutions are evolving to offer seamless integration with edge devices and platforms. This trend aligns with the growing need for real-time data analytics and decision support in industrial settings, driving the development of more intelligent and responsive IWSN solutions.

Convergence of Wireless Sensor Networks and Artificial Intelligence:

Another significant trend in the Global Industrial Wireless Sensor Networks (IWSN) Market is the convergence of wireless sensor networks with artificial intelligence (AI) and machine learning (ML) technologies. This convergence is reshaping how industrial organizations collect, analyze, and derive actionable insights from sensor data, unlocking new levels of efficiency and intelligence.

AI and ML technologies enable IWSN systems to move beyond basic data collection and monitoring. They empower organizations to extract valuable patterns, trends, and predictive insights from sensor data, enhancing decision-making and automation. For example, predictive maintenance algorithms can analyze sensor data to anticipate equipment failures, allowing for proactive maintenance and reduced downtime. One prominent application of AI in IWSN is anomaly detection. Machine learning models can be trained to recognize abnormal patterns or deviations in sensor data, signaling potential issues or security threats. This capability is particularly valuable in industries where equipment failures or operational deviations can have severe consequences, such as manufacturing, energy, and healthcare. Additionally, AI-driven analytics can optimize resource allocation and energy management in industrial facilities. Sensors monitoring energy consumption, temperature, and environmental conditions can feed

data into AI models, which can then recommend energy-saving strategies, heating and cooling adjustments, and equipment scheduling to reduce costs and environmental impact. The convergence of IWSN and AI also extends to robotics and automation. Wireless sensors enable robots and autonomous vehicles to collect real-time environmental data, facilitating safe and precise navigation. AI algorithms can process this data to make split-second decisions, enhancing the agility and safety of autonomous systems in industrial environments. Furthermore, the integration of AI and IWSN solutions is making it easier for organizations to leverage historical data for predictive analytics. Machine learning models can analyze vast datasets to identify long-term trends, optimize processes, and support strategic decision-making. In summary, the convergence of wireless sensor networks and artificial intelligence is a compelling trend in the IWSN market. It empowers organizations to harness the full potential of sensor data, transforming it into actionable insights and intelligent automation. As AI and ML technologies continue to advance, their integration with IWSN is expected to drive further innovation and efficiency gains in industrial processes.

Enhanced Security Measures for Industrial Wireless Sensor Networks:

The Global Industrial Wireless Sensor Networks (IWSN) Market is experiencing a notable trend focused on enhancing security measures to protect sensitive data and critical industrial processes. As the adoption of IWSN solutions grows across various industries, addressing security concerns has become paramount, especially given the potential consequences of security breaches in industrial environments.

One of the key drivers of this trend is the recognition of the unique security challenges posed by IWSN deployments. Unlike traditional wired networks, wireless sensor networks are susceptible to various security threats, including eavesdropping, data interception, jamming, and unauthorized access. Consequently, industrial organizations are placing greater emphasis on fortifying the security of their IWSN systems.

To address these security challenges, several developments and strategies are shaping the IWSN market:

The use of robust encryption protocols and authentication mechanisms has become standard practice in IWSN deployments. Data transmitted between sensors, gateways, and control systems is encrypted to prevent interception or tampering. Multi-factor authentication and secure key management are employed to ensure that only authorized devices can access the network.

The implementation of IDS is gaining traction in IWSN environments. These systems continuously monitor network traffic and sensor behavior, detecting anomalies or suspicious activities. IDS can trigger alerts and initiate automated responses to mitigate potential threats.

Security starts at the device level, with manufacturers increasingly focusing on secure firmware development and over-the-air (OTA) update mechanisms. Regular firmware updates are essential to patch vulnerabilities and protect against emerging threats.

IWSN solutions are increasingly adopting security-by-design principles. This involves considering security aspects at every stage of solution development, from sensor node design to network architecture and software development. Security assessments, vulnerability testing, and threat modeling are integral to the design process.

Zero-trust security models are gaining prominence in IWSN deployments. These models assume that no device or user should be trusted by default, requiring continuous authentication and authorization for all network activity. Zero-trust architectures provide a robust defense against insider threats and unauthorized access.

Security Standards and Compliance: Industrial organizations are placing greater importance on adhering to security standards and regulatory compliance. Frameworks such as NIST Cybersecurity Framework, ISA/IEC 62443, and ISO 27001 are being adopted to guide security practices within IWSN environments. This trend reflects the growing awareness of cybersecurity risks in industrial settings and the commitment to safeguarding critical infrastructure and data. As IWSN solutions continue to expand in scope and complexity, robust security measures will remain a central focus, ensuring the integrity, confidentiality, and availability of industrial data and processes.

Segmental Insights

Sensor Insights

Pressure sensors are the dominating segment in the global industrial wireless sensor networks market by sensor type. This is attributed to the wide range of applications of pressure sensors in industrial wireless sensor networks, such as process monitoring, machine monitoring, and safety monitoring.

Pressure sensors are used to measure the pressure of fluids and gases. They are used in a variety of industrial applications, such as oil and gas, petrochemicals, power

generation, and manufacturing.

The demand for pressure sensors in industrial wireless sensor networks is being driven by a number of factors, including the increasing need for process automation, the growing adoption of the Internet of Things (IoT), and the rising safety and environmental concerns in the industrial sector.

The temperature sensors segment is also expected to grow during the forecast period, but at a slower pace than the pressure sensor segment. This is because temperature sensors are less widely used in industrial wireless sensor networks than pressure sensors. However, temperature sensors are becoming increasingly important in certain applications, such as food and beverage processing and pharmaceutical manufacturing.

The level sensors segment is expected to grow at the slowest pace during the forecast period. This is because level sensors are typically used in applications where it is not necessary to monitor the level of a fluid or gas wirelessly. However, level sensors are becoming increasingly important in certain applications, such as wastewater management and environmental monitoring.

Overall, pressure sensors are the dominating segment in the global industrial wireless sensor networks market by sensor type. This is attributed to the wide range of applications of pressure sensors in industrial wireless sensor networks. The temperature sensors and level sensors segments are also expected to grow during the forecast period, but at a slower pace than the pressure sensor segment.

Regional Insights

North America is the dominating region in the global industrial wireless sensor networks market. This is attributed to the presence of major market vendors such as Emerson Electric, Honeywell International, and General Electric, as well as the high adoption of industrial wireless sensor networks in the region. The North American industrial wireless sensor networks market is expected to maintain its dominance during the forecast period. This is due to the increasing demand for process automation, the growing adoption of the Internet of Things (IoT), and the rising safety and environmental concerns in the industrial sector. The Asia Pacific region is expected to be the fastest-growing region in the global industrial wireless sensor networks market during the forecast period. This is attributed to the rising deployment of industrial wireless sensor networks in developing countries such as China and India. The Asia Pacific region is also witnessing a growing demand for process automation and the IoT. Other regions,

such as Europe, South America, and the Middle East and Africa, are also expected to witness growth in the industrial wireless sensor networks market during the forecast period. However, the growth rate is expected to be slower than that of the Asia Pacific region. Overall, North America is the dominating region in the global industrial wireless sensor networks market. This is due to the presence of major market vendors and the high adoption of industrial wireless sensor networks in the region. The Asia Pacific region is expected to be the fastest-growing region during the forecast period.

Key Market Players

ABB Ltd.

KUKA AG

FANUC Corporation

Yaskawa Electric Corporation

Siemens AG

Schneider Electric SE

Honeywell International Inc.:

Cisco Systems, Inc.

Lenovo Group Limited

NVIDIA Corporation

Report Scope:

In this report, the Global Industrial Wireless Sensor Networks Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Industrial Wireless Sensor Networks Market, By Sensor:

Pressure Sensor

Temperature Sensor

Contents

1. PRODUCT OVERVIEW

- 1.1. Market Definition
- 1.2. Scope of the Market
 - 1.2.1. Markets Covered
 - 1.2.2. Years Considered for Study
 - 1.2.3. Key Market Segmentations

2. RESEARCH METHODOLOGY

- 2.1. Objective of the Study
- 2.2. Baseline Methodology
- 2.3. Formulation of the Scope
- 2.4. Assumptions and Limitations
- 2.5. Sources of Research
 - 2.5.1. Secondary Research
 - 2.5.2. Primary Research
- 2.6. Approach for the Market Study
 - 2.6.1. The Bottom-Up Approach
 - 2.6.2. The Top-Down Approach
- 2.7. Methodology Followed for Calculation of Market Size & Market Shares
- 2.8. Forecasting Methodology
 - 2.8.1. Data Triangulation & Validation

3. EXECUTIVE SUMMARY

4. VOICE OF CUSTOMER

5. GLOBAL INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OVERVIEW

6. GLOBAL INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

- 6.1. Market Size & Forecast
 - 6.1.1. By Value

6.2. Market Share & Forecast

6.2.1. By Sensor (Pressure Sensor, Temperature Sensor, Level Sensor, Flow Sensor, Biosensor, and Others)

6.2.2. By Technology (Zigbee, Bluetooth, Wi-Fi, and Others)

6.2.3. By Industry Vertical (Oil & Gas, Automotive, Manufacturing, Healthcare, and Others)

6.2.4. By Region (North America, Europe, South America, Middle East & Africa, Asia Pacific)

6.3. By Company (2022)

6.4. Market Map

7. NORTH AMERICA INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

7.1. Market Size & Forecast

7.1.1. By Value

7.2. Market Share & Forecast

7.2.1. By Sensor

7.2.2. By Technology

7.2.3. By Industry Vertical

7.2.4. By Country

7.3. North America: Country Analysis

7.3.1. United States Industrial Wireless Sensor Networks Market Outlook

7.3.1.1. Market Size & Forecast

7.3.1.1.1. By Value

7.3.1.2. Market Share & Forecast

7.3.1.2.1. By Sensor

7.3.1.2.2. By Technology

7.3.1.2.3. By Industry Vertical

7.3.2. Canada Industrial Wireless Sensor Networks Market Outlook

7.3.2.1. Market Size & Forecast

7.3.2.1.1. By Value

7.3.2.2. Market Share & Forecast

7.3.2.2.1. By Sensor

7.3.2.2.2. By Technology

7.3.2.2.3. By Industry Vertical

7.3.3. Mexico Industrial Wireless Sensor Networks Market Outlook

7.3.3.1. Market Size & Forecast

7.3.3.1.1. By Value

- 7.3.3.2. Market Share & Forecast
 - 7.3.3.2.1. By Sensor
 - 7.3.3.2.2. By Technology
 - 7.3.3.2.3. By Industry Vertical

8. EUROPE INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

- 8.1. Market Size & Forecast
 - 8.1.1. By Value
- 8.2. Market Share & Forecast
 - 8.2.1. By Sensor
 - 8.2.2. By Technology
 - 8.2.3. By Industry Vertical
 - 8.2.4. By Country
- 8.3. Europe: Country Analysis
 - 8.3.1. Germany Industrial Wireless Sensor Networks Market Outlook
 - 8.3.1.1. Market Size & Forecast
 - 8.3.1.1.1. By Value
 - 8.3.1.2. Market Share & Forecast
 - 8.3.1.2.1. By Sensor
 - 8.3.1.2.2. By Technology
 - 8.3.1.2.3. By Industry Vertical
 - 8.3.2. France Industrial Wireless Sensor Networks Market Outlook
 - 8.3.2.1. Market Size & Forecast
 - 8.3.2.1.1. By Value
 - 8.3.2.2. Market Share & Forecast
 - 8.3.2.2.1. By Sensor
 - 8.3.2.2.2. By Technology
 - 8.3.2.2.3. By Industry Vertical
 - 8.3.3. United Kingdom Industrial Wireless Sensor Networks Market Outlook
 - 8.3.3.1. Market Size & Forecast
 - 8.3.3.1.1. By Value
 - 8.3.3.2. Market Share & Forecast
 - 8.3.3.2.1. By Sensor
 - 8.3.3.2.2. By Technology
 - 8.3.3.2.3. By Industry Vertical
 - 8.3.4. Italy Industrial Wireless Sensor Networks Market Outlook
 - 8.3.4.1. Market Size & Forecast
 - 8.3.4.1.1. By Value

- 8.3.4.2. Market Share & Forecast
 - 8.3.4.2.1. By Sensor
 - 8.3.4.2.2. By Technology
 - 8.3.4.2.3. By Industry Vertical
- 8.3.5. Spain Industrial Wireless Sensor Networks Market Outlook
 - 8.3.5.1. Market Size & Forecast
 - 8.3.5.1.1. By Value
 - 8.3.5.2. Market Share & Forecast
 - 8.3.5.2.1. By Sensor
 - 8.3.5.2.2. By Technology
 - 8.3.5.2.3. By Industry Vertical
- 8.3.6. Belgium Industrial Wireless Sensor Networks Market Outlook
 - 8.3.6.1. Market Size & Forecast
 - 8.3.6.1.1. By Value
 - 8.3.6.2. Market Share & Forecast
 - 8.3.6.2.1. By Sensor
 - 8.3.6.2.2. By Technology
 - 8.3.6.2.3. By Industry Vertical

9. SOUTH AMERICA INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

- 9.1. Market Size & Forecast
 - 9.1.1. By Value
- 9.2. Market Share & Forecast
 - 9.2.1. By Sensor
 - 9.2.2. By Technology
 - 9.2.3. By Industry Vertical
 - 9.2.4. By Country
- 9.3. South America: Country Analysis
 - 9.3.1. Brazil Industrial Wireless Sensor Networks Market Outlook
 - 9.3.1.1. Market Size & Forecast
 - 9.3.1.1.1. By Value
 - 9.3.1.2. Market Share & Forecast
 - 9.3.1.2.1. By Sensor
 - 9.3.1.2.2. By Technology
 - 9.3.1.2.3. By Industry Vertical
 - 9.3.2. Colombia Industrial Wireless Sensor Networks Market Outlook
 - 9.3.2.1. Market Size & Forecast

- 9.3.2.1.1. By Value
- 9.3.2.2. Market Share & Forecast
 - 9.3.2.2.1. By Sensor
 - 9.3.2.2.2. By Technology
 - 9.3.2.2.3. By Industry Vertical
- 9.3.3. Argentina Industrial Wireless Sensor Networks Market Outlook
 - 9.3.3.1. Market Size & Forecast
 - 9.3.3.1.1. By Value
 - 9.3.3.2. Market Share & Forecast
 - 9.3.3.2.1. By Sensor
 - 9.3.3.2.2. By Technology
 - 9.3.3.2.3. By Industry Vertical
- 9.3.4. Chile Industrial Wireless Sensor Networks Market Outlook
 - 9.3.4.1. Market Size & Forecast
 - 9.3.4.1.1. By Value
 - 9.3.4.2. Market Share & Forecast
 - 9.3.4.2.1. By Sensor
 - 9.3.4.2.2. By Technology
 - 9.3.4.2.3. By Industry Vertical
- 9.3.5. Peru Industrial Wireless Sensor Networks Market Outlook
 - 9.3.5.1. Market Size & Forecast
 - 9.3.5.1.1. By Value
 - 9.3.5.2. Market Share & Forecast
 - 9.3.5.2.1. By Sensor
 - 9.3.5.2.2. By Technology
 - 9.3.5.2.3. By Industry Vertical

10. MIDDLE EAST & AFRICA INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

- 10.1. Market Size & Forecast
 - 10.1.1. By Value
- 10.2. Market Share & Forecast
 - 10.2.1. By Sensor
 - 10.2.2. By Technology
 - 10.2.3. By Industry Vertical
 - 10.2.4. By Country
- 10.3. Middle East & Africa: Country Analysis
 - 10.3.1. Saudi Arabia Industrial Wireless Sensor Networks Market Outlook

- 10.3.1.1. Market Size & Forecast
 - 10.3.1.1.1. By Value
- 10.3.1.2. Market Share & Forecast
 - 10.3.1.2.1. By Sensor
 - 10.3.1.2.2. By Technology
 - 10.3.1.2.3. By Industry Vertical
- 10.3.2. UAE Industrial Wireless Sensor Networks Market Outlook
 - 10.3.2.1. Market Size & Forecast
 - 10.3.2.1.1. By Value
 - 10.3.2.2. Market Share & Forecast
 - 10.3.2.2.1. By Sensor
 - 10.3.2.2.2. By Technology
 - 10.3.2.2.3. By Industry Vertical
- 10.3.3. South Africa Industrial Wireless Sensor Networks Market Outlook
 - 10.3.3.1. Market Size & Forecast
 - 10.3.3.1.1. By Value
 - 10.3.3.2. Market Share & Forecast
 - 10.3.3.2.1. By Sensor
 - 10.3.3.2.2. By Technology
 - 10.3.3.2.3. By Industry Vertical
- 10.3.4. Turkey Industrial Wireless Sensor Networks Market Outlook
 - 10.3.4.1. Market Size & Forecast
 - 10.3.4.1.1. By Value
 - 10.3.4.2. Market Share & Forecast
 - 10.3.4.2.1. By Sensor
 - 10.3.4.2.2. By Technology
 - 10.3.4.2.3. By Industry Vertical
- 10.3.5. Israel Industrial Wireless Sensor Networks Market Outlook
 - 10.3.5.1. Market Size & Forecast
 - 10.3.5.1.1. By Value
 - 10.3.5.2. Market Share & Forecast
 - 10.3.5.2.1. By Sensor
 - 10.3.5.2.2. By Technology
 - 10.3.5.2.3. By Industry Vertical

11. ASIA PACIFIC INDUSTRIAL WIRELESS SENSOR NETWORKS MARKET OUTLOOK

11.1. Market Size & Forecast

- 11.1.1. By Sensor
- 11.1.2. By Technology
- 11.1.3. By Industry Vertical
- 11.1.4. By Country
- 11.2. Asia-Pacific: Country Analysis
 - 11.2.1. China Industrial Wireless Sensor Networks Market Outlook
 - 11.2.1.1. Market Size & Forecast
 - 11.2.1.1.1. By Value
 - 11.2.1.2. Market Share & Forecast
 - 11.2.1.2.1. By Sensor
 - 11.2.1.2.2. By Technology
 - 11.2.1.2.3. By Industry Vertical
 - 11.2.2. India Industrial Wireless Sensor Networks Market Outlook
 - 11.2.2.1. Market Size & Forecast
 - 11.2.2.1.1. By Value
 - 11.2.2.2. Market Share & Forecast
 - 11.2.2.2.1. By Sensor
 - 11.2.2.2.2. By Technology
 - 11.2.2.2.3. By Industry Vertical
 - 11.2.3. Japan Industrial Wireless Sensor Networks Market Outlook
 - 11.2.3.1. Market Size & Forecast
 - 11.2.3.1.1. By Value
 - 11.2.3.2. Market Share & Forecast
 - 11.2.3.2.1. By Sensor
 - 11.2.3.2.2. By Technology
 - 11.2.3.2.3. By Industry Vertical
 - 11.2.4. South Korea Industrial Wireless Sensor Networks Market Outlook
 - 11.2.4.1. Market Size & Forecast
 - 11.2.4.1.1. By Value
 - 11.2.4.2. Market Share & Forecast
 - 11.2.4.2.1. By Sensor
 - 11.2.4.2.2. By Technology
 - 11.2.4.2.3. By Industry Vertical
 - 11.2.5. Australia Industrial Wireless Sensor Networks Market Outlook
 - 11.2.5.1. Market Size & Forecast
 - 11.2.5.1.1. By Value
 - 11.2.5.2. Market Share & Forecast
 - 11.2.5.2.1. By Sensor
 - 11.2.5.2.2. By Technology

- 11.2.5.2.3. By Industry Vertical
- 11.2.6. Indonesia Industrial Wireless Sensor Networks Market Outlook
 - 11.2.6.1. Market Size & Forecast
 - 11.2.6.1.1. By Value
 - 11.2.6.2. Market Share & Forecast
 - 11.2.6.2.1. By Sensor
 - 11.2.6.2.2. By Technology
 - 11.2.6.2.3. By Industry Vertical
- 11.2.7. Vietnam Industrial Wireless Sensor Networks Market Outlook
 - 11.2.7.1. Market Size & Forecast
 - 11.2.7.1.1. By Value
 - 11.2.7.2. Market Share & Forecast
 - 11.2.7.2.1. By Sensor
 - 11.2.7.2.2. By Technology
 - 11.2.7.2.3. By Industry Vertical

12. MARKET DYNAMICS

- 12.1. Drivers
- 12.2. Challenges

13. MARKET TRENDS AND DEVELOPMENTS

14. COMPANY PROFILES

- 14.1. ABB Ltd.
 - 14.1.1. Business Overview
 - 14.1.2. Key Revenue and Financials
 - 14.1.3. Recent Developments
 - 14.1.4. Key Personnel/Key Contact Person
 - 14.1.5. Key Product/Services Offered
- 14.2. KUKA AG
 - 14.2.1. Business Overview
 - 14.2.2. Key Revenue and Financials
 - 14.2.3. Recent Developments
 - 14.2.4. Key Personnel/Key Contact Person
 - 14.2.5. Key Product/Services Offered
- 14.3. FANUC Corporation

- 14.3.1. Business Overview
- 14.3.2. Key Revenue and Financials
- 14.3.3. Recent Developments
- 14.3.4. Key Personnel/Key Contact Person
- 14.3.5. Key Product/Services Offered
- 14.4. Yaskawa Electric Corporation
 - 14.4.1. Business Overview
 - 14.4.2. Key Revenue and Financials
 - 14.4.3. Recent Developments
 - 14.4.4. Key Personnel/Key Contact Person
 - 14.4.5. Key Product/Services Offered
- 14.5. Siemens AG
 - 14.5.1. Business Overview
 - 14.5.2. Key Revenue and Financials
 - 14.5.3. Recent Developments
 - 14.5.4. Key Personnel/Key Contact Person
 - 14.5.5. Key Product/Services Offered
- 14.6. Schneider Electric SE
 - 14.6.1. Business Overview
 - 14.6.2. Key Revenue and Financials
 - 14.6.3. Recent Developments
 - 14.6.4. Key Personnel/Key Contact Person
 - 14.6.5. Key Product/Services Offered
- 14.7. Cisco Systems, Inc.
 - 14.7.1. Business Overview
 - 14.7.2. Key Revenue and Financials
 - 14.7.3. Recent Developments
 - 14.7.4. Key Personnel/Key Contact Person
 - 14.7.5. Key Product/Services Offered
- 14.8. Honeywell International Inc.:
 - 14.8.1. Business Overview
 - 14.8.2. Key Revenue and Financials
 - 14.8.3. Recent Developments
 - 14.8.4. Key Personnel/Key Contact Person
 - 14.8.5. Key Product/Services Offered
- 14.9. Lenovo Group Limited
 - 14.9.1. Business Overview
 - 14.9.2. Key Revenue and Financials
 - 14.9.3. Recent Developments

14.9.4. Key Personnel/Key Contact Person

14.9.5. Key Product/Services Offered

14.10. NVIDIA Corporation

14.10.1. Business Overview

14.10.2. Key Revenue and Financials

14.10.3. Recent Developments

14.10.4. Key Personnel/Key Contact Person

14.10.5. Key Product/Services Offered

15. STRATEGIC RECOMMENDATIONS

16. ABOUT US & DISCLAIMER

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